

EXPERIMENTAL AND NUMERICAL RESULTS FOR A LIQUID HYDROGEN TURBOPUMP WITH SEAL CAVITIES

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Effective sealing in secondary flow paths is critical to the performance of rocket turbopumps. It is important to be able to predict seal performance and the interaction of seal flows on the main flow in order for the designer to properly assess the impact of a particular seal design on the overall system performance. This paper presents the results of a series of Computational Fluid Dynamics (CFD) calculations of the First Stage SSME ATD LH₂ Rocket Turbopump with seal cavities and compares the CFD results to experimental data over a range of operating points.

It was seen that the CFD could predict the trends in the experimental data although the exact pressure drop through the seal cavity was not predicted. It was surmised that the discrepancy was due to the turbulence model that cannot capture the complex stress-strain fields that are present in the seal cavity.

In addition, the CFD calculations indicated that the location of the seal cavity flow injection into the impeller eye region could be an important design criterion for both the seal cavity and the impeller. The pressure disturbance from the presence of the impeller leading edge caused the flow to locally reverse direction from the expected direction and went back into the seal cavity. More study is required to investigate this phenomenon and determine its effect on the system performance.